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METHODS FOR THERMAL SHOCK TESTS ON GLASSWARE

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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July 1972

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METHODS FOR THERMAL SHOCK TESTS ON GLASSWARE

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Indian Standard

METHODS FOR THERMAL SHOCK TESTS ON GLASSWARE

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 2 February 1972, after the draft finalized by the Glassware Sectional Committee had been approved by the Chemical Division Council.

0.2 The term ' thermal shock ' is used to refer to the strain produced when a temperature difference is suddenly created between the inner and outer walls of a container. Such temperature differences occur in various ways in practice. Assessment of the ability of a glass container to withstand thermal shock is, therefore, essential to ensure satisfactory service.

0.3 For test purposes the most direct and severe way of producing thermal shock is to heat the article by placing it in a hot air-oven or by immersing it in a hot water-bath at a known temperature and then transferring it to a cold water-bath or spraying cold water on it, thus chilling the outside surface. However, to obtain reproducible results it is essential that factors such as period of keeping the article in hot air-oven or its immersion in hot water-bath, time of transfer and method of controlling temperature and keeping it uniform are standardized. Further, keeping in view the end use of the article and the severity of thermal shock required, four methods of test have been prescribed in this standard.

0.4 In the formulation of this standard due weightage has been given to international coordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country. This has been met by basing the standard on ISO/R 718 ' Methods for thermal shock tests on laboratory glassware ' issued by the International Organization for Standardization (ISO).

0.4.1 Assistance has also been rendered by the Central Glass and Ceramic Research Institute, Calcutta in the development and finalization of the method applicable to flat ware.

0.5 This standard is one of the series of Indian Standards on testing th quality of glassware. Other standards published so far in the series are:

IS : 2303-1963 Method of grading glass for alkalinity

IS : 5633-1970 Method for determination of coefficient of linea thermal expansion of glass

0.6 In reporting the result of a test made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960*.

1. SCOPE

1.1 This standard prescribes methods of test intended to assess resistance of glassware to thermal shock arising from a predetermined change in temperature.

1.1.1 Four methods are prescribed as follows:

Method A — for testing whole articles at temperature differences of less than 100°C,

Method B — for testing whole articles at temperature differences of 100°C or more,

Method C — for testing the rims of articles, and

Method D — for testing flat or shallow articles.

NOTE — Method B may also be used for testing small articles at temperature differences of less than 100°C in cases where Method A is inappropriate.

2. PRINCIPLE

2.1 The thermal shock is measured by the difference between the upper temperature t_1 to which the article is heated, and the lower temperature t_2 of the cold water-bath, in which the article is placed, or the cold water spray to which the article is subjected.

3. SAMPLING

3.1 The number of articles to be taken as sample from a consignment shall be as specified in the relevant material specification.

4. APPARATUS

4.1 Method A — two baths, of a capacity of at least 5 litres. One of the baths shall be provided with a suitable means of heating. Each bath shall be provided with a suitable stirrer or any other device to ensure a uniform temperature throughout the bath. A thermometer of suitable range (*see* IS : 2480-1964†) capable of being read to an accuracy of ± 1°C shall also be provided in each bath.

4.2 Method B

4.2.1 *Water-Bath* — one, similar to the one prescribed in **4.1.1** but without any means of heating.

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*Rules for rounding off numerical values (*revised*).

†Specification for general purpose glass thermometers.

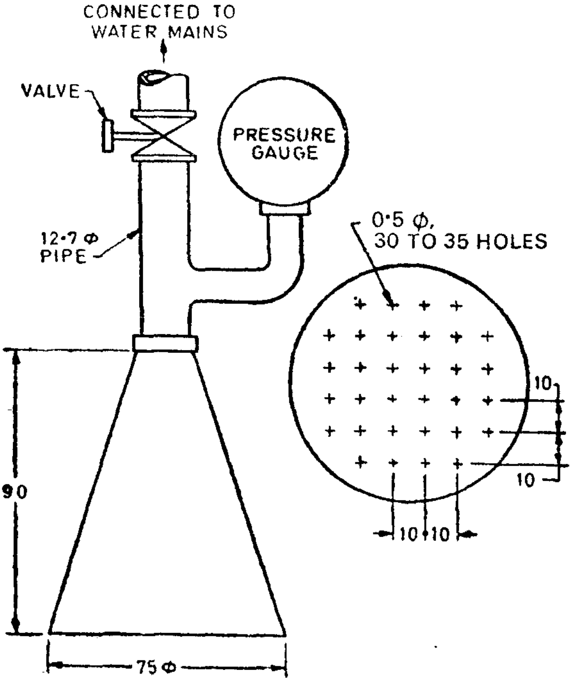
4.2.2 *Air-Oven* — with temperature range of 35 to 250°C and provided with an air stirrer or circulator to ensure uniformity of temperature. The oven shall also have a thermostat capable of maintaining the temperature constant ±1°C up to 180°C and ±2°C between 180 and 250°C. The oven shall also be provided with a thermometer of suitable range (*see* IS : 2480-1964*) capable of being read to an accuracy of ±1°C.

4.3 Method C — for water-baths *see* **4.2.1.**

4.4 Method D

4.4.1 *Air-Oven* — same as prescribed in **4.2.2.**

4.4.2 *Water Sprayer* — The sprayer shall be of the shape and size as shown in Fig. 1. The spraying face shall have 30 to 35 holes of 0·5 mm diameter. These holes shall be at a distance of about 10 cm from one another.



All dimensions in millimetres.

FIG. 1 WATER SPRAYER

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*Specification for general purpose glass thermometers.

5. PROCEDURE

5.0 General — Articles which do not break in the test shall not be used for further testing. In Method A, a wire-net basket may be used for holding articles for immersing in the hot water-bath and then transferring them to the cold water-bath. Similarly, in Methods B, C and D asbestos on the tips of the tongs, used in removing articles from the air-oven, shall be kept dry.

5.1 Method A — Fill both the baths with water and adjust the temperature to $t_1 \pm 1$°C taking for convenience the temperature of the tap water as t_2, and selecting t_1 to give the required thermal shock $(t_1 - t_2)$°C. The range may be extended to nearly 100°C by using ice-water in the cold water-bath. Immerse the sample articles in the bath at temperature t_1, so that they are filled with water. Allow to soak for 15 minutes, the temperature of the bath being maintained constant to $t_1 \pm 1$°C and noted.

5.1.1 Then transfer each of the samples, filled with water, to the bath at temperature t_2, completing the process of transference in 10 ± 2 seconds for each article, and immerse almost completely in the bath, for a specified period, which shall not exceed two minutes, without allowing cold water to enter them.

5.1.2 Finally examine the articles for any damage or cracks.

5.2 Method B — Heat the air-oven and adjust the temperature to $t_1 \pm 1$°C, taking for convenience the temperature of tap water in the cold water-bath as t_2, and selecting t_1 to give the required thermal shock $(t_1 - t_2)$°C. Place the articles in the oven and maintain for 30 minutes.

5.2.1 Then remove the articles from the air-oven, one at a time, by means of tongs with asbestos-covered tips, completing the process of transference in 5 ± 1 seconds for each articles, and immerse the article to half the height of the body (that is, total height less neck, if any) in the cold water-bath for a specified period which shall not exceed two minutes.

5.2.2 Finally examine the articles for any damage or cracks.

5.3 Method C — Heat the air-oven and adjust the temperature to $t_1 \pm 1$°C as prescribed in **5.2**. Place the articles in the oven and maintain for 30 minutes.

5.3.1 Then remove the articles from the air-oven, one at a time, by means of tongs with asbestos-covered tips, completing the process of transference in 5 ± 1 seconds for each article, and immerse the rim to be tested, in the cold water-bath, to a depth of about 25 mm for a specified period which shall not exceed two minutes, without allowing the entrapped air to escape.

5.3.2 Finally examine the rims for any damage or cracks.

5.4 Method D — Heat the air-oven and adjust the temperature to $t_1 \pm 1$°C, taking for convenience the temperature of tap water to be sprayed as t_2 and selecting t_1 to give the required thermal shock ($t_1 - t_2$)°C. Place the articles in the air-oven and maintain for 30 minutes.

5.4.1 Then remove the articles from the air-oven, one at a time, by means of tongs with asbestos-covered tips, completing the process of transference in 5 ± 1 seconds for each article, and spray tap water from the sprayer on the convex side of the article for a specified period which shall not exceed one minute, without allowing the concave side of the article to become wet. The spraying shall be done at a pressure of 1 kgf/cm^2 keeping the surface to be sprayed at a distance of about 30 cm from the sprayer.

5.4.2 Finally examine the articles for any damage or cracks.

6. EXPRESSION OF RESULTS

6.1 Articles which do not chip, crack or break shall be considered to have passed the test.

6.2 The report shall state:

- a) the number of articles in the consignment;
- b) the number taken as a sample;
- c) the method of test used (that is, A, B, C, or D);
- d) the number passing the test; and
- e) the thermal shock expressed at ($t_1 - t_2$)°C.

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